PTO-1390 (Modified) 1-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: **MTR.0032US**

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR): **10/031424**

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/FR00/02105	**21 July 2000 (21.07.2000)**	**26 July 1999 (26.07.1999)**

TITLE OF INVENTION

METHOD AND DEVICE FOR FORMING TRANSPORT FRAMES FROM CODED-SIGNAL FRAMES AND DEVICE FOR EXTRACTING CODED SIGNAL FRAMES

APPLICANT(S) FOR DO/EO/US

ALBERT-PATRICK KRIEF and PIERRE FORCE

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☒ is attached hereto (required only if not communicated by the International Bureau).
   b. ☐ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

    Four (4) sheets of formal drawings.

APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/031424	PCT/FR00/02105	MTR.0032US

24. The following fees are submitted:.	CALCULATIONS PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :	
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1040.00**	
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$890.00**	
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$740.00**	
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$710.00**	
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**	
ENTER APPROPRIATE BASIC FEE AMOUNT =	**$890.00**
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☒ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	**$130.00**

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	13 - 20 =	0	x $18.00	**$3.00**
Independent claims	- 3 =	0	x $84.00	**$0.00**
Multiple Dependent Claims **(check if applicable)**.			☐	**$0.00**
TOTAL OF ABOVE CALCULATIONS			=	**$1,023.00**
Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.				**$0.00**
SUBTOTAL			=	**$1,023.00**
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).			+	**$0.00**
TOTAL NATIONAL FEE			=	**$1,023.00**
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).**			☐	**$0.00**
TOTAL FEES ENCLOSED			=	**$1,023.00**
			Amount to be: refunded	$
			charged	$

a. ☒ A check in the amount of **$1,023.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **20-1504** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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21906
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SIGNATURE

Dan C. Hu
NAME

40,025
REGISTRATION NUMBER

1-18-02
DATE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Albert-Patrick Krief et al.	§	
		§	
Int'l Appl. No.:	PCT/FR00/02105	§	
		§	
Int'l Filing Date:	July 21, 2000	§	
		§	
For:	Method And Device For Forming Transport Frames From Coded-Signal Frames And Device For Extracting Coded Signal Frames	§	Atty. Dkt. No.: MTR.0032US

Box PCT
Commissioner for Patents
Washington DC 20231

Attn: DO/EO/US

CERTIFICATE OF MAILING BY EXPRESS MAIN
(37 C.F.R. § 1.10)

Sir:

I certify that the following correspondence:

1. Transmittal Letter to the United States Designated/Elected Office (DO/EO/US) Concerning a Filing Under 35 U.S.C. 371;
2. Copy of Published International Application No. PCT/FR00/02105;
3. English Language Translation of International Application No. PCT/FR00/02105;
4. Copy of International Search Report;
5. Copy of International Examination Report;
6. Preliminary Amendment;
7. Four (4) sheets of formal drawings;
8. Certificate of Mailing by Express Mail;
9. Check for $1,023; and
10. Postcard

is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. § 1.10 in an envelope addressed to: Box PCT, Commissioner for Patents, Washington DC 20231 on January 18, 2002.

Dan C. Hu
(Typed or printed name of person mailing correspondence)

(Signature of person mailing correspondence)

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Albert-Patrick Krief et al.	§	
Int'l Appl. No.:	PCT/FR00/02105	§	
Int'l Filing Date:	July 21, 2000	§	
For:	Method And Device For Forming Transport Frames From Coded-Signal Frames And Device For Extracting Coded Signal Frames	§	Atty. Dkt. No.: MTR.0032US

Box PCT
Commissioner for Patents
Washington DC 20231

PRELIMINARY AMENDMENT

Sir:

Prior to Examination, please amend the above-identified application as follows

In the Title:

Replace the title with --METHOD AND DEVICE FOR FORMING TRANSPORT FRAMES FROM CODED-SIGNAL FRAMES AND DEVICE FOR EXTRACTING CODED SIGNAL FRAMES--.

In the Specification:

Page 1, at line 4, please insert the following paragraph:

--BACKGROUND OF THE INVENTION--

Page 3, at line 18, please insert the following paragraph:

--SUMMARY OF THE INVENTION--

Page 6, delete lines 1-4.

Page 6, at line 5, please insert the following paragraph:

--BRIEF DESCRIPTION OF THE DRAWINGS--

Page 6, at line 13, insert the following paragraph:

--DETAILED DESCRIPTION--

In the Abstract:

Please replace the abstract with the following:

-- Transport frames to be transmitted on a communication channel are formed from coded-signal frames. Each coded-signal frame comprises one or more sets of bits to be protected against transmission errors. A respective error detection code is calculated for a subset of bits, and placed in a respective transport frame along with this subset of bits. Some at least of the transport frames contain a plurality of subsets of bits, emanating from different coded-signal frames and accompanied by the corresponding error detection codes.--

In the Claims:

Amend the following claims:

1. (Amended) Method for forming transport frames to be transmitted on a communication channel, from coded-signal frames, wherein each coded-signal frame comprises at least one set of bits to be protected against transmission errors, the method comprising the steps of:

calculating a respective error detection code for at least one subset of bits included in said at least one set; and

placing said at least one subset of bits in a respective transport frame with the error detection code calculated therefor,

wherein some at least of the transport frames contain a plurality of subsets of bits, emanating from different coded-signal frames and accompanied by the respective error detection codes calculated therefor.

2. (Amended) The method as claimed in claim 1, wherein the number of bits of said subsets varies from one coded-signal frame to another, and the number of bits of the error detection code calculated for a subset of bits is an increasing function of the number of bits of said subset.

3. (Amended) The method as claimed in claim 1, wherein, in each transport frame, the total number of bits from said sets of bits to be protected is constant, as well as the total number of bits of said error detection codes.

4. (Amended) Device for forming transport frames to be transmitted on a communication channel, from coded-signal frames, wherein each coded-signal frame

comprises at least one set of bits to be protected against transmission errors, including at least one subset of bits, the device comprising:

means for calculating a respective error detection code for said at least one subset of bits; and

multiplexing means for placing said at least one subset of bits in a transport frame with the error detection code calculated therefor,

wherein the multiplexing means are arranged to place a plurality of subsets of bits, emanating from different coded-signal frames and accompanied by the respective error detection codes calculated therefor, in some at least of the transport frames.

5. (Amended) The device as claimed in claim 4, wherein the number of bits of said subsets varies from one coded-signal frame to another, and the number of bits of the error detection code calculated for a subset of bits is an increasing function of the number of bits of said subset.

6. (Amended) The device as claimed in claim 4, wherein, in each transport frame, the total number of bits from said sets of bits to be protected is constant, as well as the total number of bits of said error detection codes.

7. (Amended) The device as claimed in claim 6, further comprising coding means for applying, in each transport frame, an error correcting code to a block formed by the subsets of bits originating from said sets of bits to be protected and by the error detection codes respectively calculated therefor.

8. (Amended) The device as claimed in claim 4, wherein the transport frames and the coded-signal frames are of the same duration, and the content of N consecutive coded-signal frames is inserted into M consecutive transport frames, N and M being numbers such that $N > M$.

9. (Amended) A device for extracting coded-signal frames from transport frames received on a communication channel, wherein each coded-signal frame comprises at least one set of bits protected against transmission errors, including at least one subset of bits, the device comprising demultiplexing means for extracting from each transport frame at least one of said subsets of bits, along with a respective error detection code, wherein the

demultiplexing means are arranged to extract a plurality of subsets of bits from some at least of the transport frames, and to distribute the extracted subsets of bits, associated with their respective error detection codes, in different coded-signal frames.

10. (Amended) The device as claimed in claim 9, wherein the number of bits of said subsets varies from one coded-signal frame to another, and the number of bits of the error detection code for a subset of bits is an increasing function of the number of bits of said subset.

11. (Amended) The device as claimed in claim 9, wherein, in each transport frame, the total number of bits from said sets of bits to be protected is constant, as well as the total number of bits of said error detection codes.

12. (Amended) The device as claimed in claim 11, further comprising decoding means for correcting transmission errors in a block formed, in each transport frame, by the bits pertaining to said sets of protected bits and by said error detection codes.

13. (Amended) The device as claimed in claim 9, wherein the transport frames and the coded-signal frames are of the same duration, and the content of N consecutive coded-signal frames is extracted from M consecutive transport frames, N and M being numbers such that $N > M$.

Remarks:

Allowance of all claims is respectfully requested. The Commissioner is authorized to charge any additional fees under 37 C.F.R. § 1.16 and § 1.17, or credit any overpayment to Deposit Account No. 20-1504 (MTR.0032US).

Respectfully submitted,

Date: 1-18-02

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VERSIONS WITH MARKINGS TO SHOW CHANGES

IN THE CLAIMS:

Amendments of the claims are indicated below:

1. (Amended) Method for forming transport frames, to be transmitted on a communication channel, from coded-signal frames, wherein each coded-signal frame comprises at least one set of bits to be protected against transmission errors, [including] the method comprising the steps of:

[at least one subset of bits which] calculating a respective error detection code [is calculated, and wherein each of said subsets of bits is placed in a transport frame with its respective error detection code, characterized in that some at least of the transport frames contain several subsets of bits, emanating from different coded-signal frames and accompanied by their respective error detection codes] for at least one subset of bits included in said at least one set; and

placing said at least one subset of bits in a respective transport frame with the error detection code calculated therefor,

wherein some at least of the transport frames contain a plurality of subsets of bits, emanating from different coded-signal frames and accompanied by the respective error detection codes calculated therefor.

2. (Amended) The method as claimed in claim 1, wherein the number [($q_{i,j,k}$)] of bits of said subsets varies from one coded-signal frame to another, and the number [($L_{i,j,k}$)] of bits of the error detection code calculated for a subset of bits is an increasing function of the number of bits of said subset.

3. (Amended) The method as claimed in claim 1 [or 2], wherein, in each transport frame, the total number of bits from said sets of bits to be protected is constant, as well as the total number of bits of said error detection codes.

4. (Amended) Device for forming transport frames[,] to be transmitted on a communication channel, from coded-signal frames, wherein each coded-signal frame comprises at

least one set of bits to be protected against transmission errors, including at least one subset of bits, the device comprising:

means [(23)] for calculating a respective error detection code for [each of said subsets] said at least one subset of bits;[,] and

multiplexing means [(6, 20-22, 24-26)] for placing [each of said subsets] said at least one subset of bits in a transport frame with [its respective] the error detection code calculated therefor,

[code, characterized in that] wherein the multiplexing means are arranged to place [several] a plurality of subsets of bits, emanating from different coded-signal frames and accompanied by [their] the respective error detection codes calculated therefor, in some at least of the transport frames.

5. (Amended) The device as claimed in claim 4, wherein the number [($q_{i,j,k}$)] of bits of said subsets varies from one coded-signal frame to another, and the number [($L_{i,j,k}$)] of bits of the error detection code calculated for a subset of bits is an increasing function of the number of bits of said subset.

6. (Amended) The device as claimed in claim 4 [or 5], wherein, in each transport frame, the total number of bits [originating] from said sets of bits to be protected is constant, as well as the total number of bits of said error detection codes.

7. (Amended) The device as claimed in claim 6, further comprising coding means [(27)] for applying, in each transport frame, an error correcting code to a block formed by the subsets of bits originating from said sets of bits to be protected and by the [their respective] error detection codes respectively calculated therefor.

8. (Amended) The device as claimed in [any one of claims] claim 4 [to 7], wherein the transport frames and the coded-signal frames are of the same duration, and the content of N consecutive coded-signal frames is inserted into M consecutive transport frames, N and M being numbers such that $N > M$.

9. (Amended) A device for extracting coded-signal frames from transport frames received on a communication channel, wherein each coded-signal frame comprises at least one set of bits protected against transmission errors, including at least one subset of bits, the device comprising demultiplexing means [(16, 30-32, 34-36)] for extracting from each transport frame at least one of said subsets of bits, along with a respective error detection code, [characterized in that] wherein the demultiplexing means are arranged to extract [several] a plurality of subsets of bits from some at least of the transport frames, and to distribute [these] the extracted subsets of bits, associated with their respective error detection codes, in different coded-signal frames.

10. (Amended) The device as claimed in claim 9, wherein the number [($q_{i,j,k}$)] of bits of said subsets varies from one coded-signal frame to another, and the number [($L_{i,j,k}$)]of bits of the error detection code [calculated] for a subset of bits is an increasing function of the number of bits of said subset.

11. (Amended) The device as claimed in claim 9 [or 10], wherein, in each transport frame, the total number of bits [originating] from said sets of bits to be protected is constant, as well as the total number of bits of said error detection codes.

12. (Amended) The device as claimed in claim 11, further comprising decoding means [(37)] for correcting [any] transmission errors in a block formed, in each transport frame, by the bits pertaining to said sets of protected bits and by said error detection codes.

13. (Amended) The device as claimed in [any one of claims] claim 9 [to 12], wherein the transport frames and the coded-signal frames are of the same duration, and the content of N consecutive coded-signal frames is extracted from M consecutive transport frames, N and M being numbers such that N > M.

CERTIFICATION OF TRANSLATION

I, Bertrand LOISEL, of CABINET PLASSERAUD, 84, rue d'Amsterdam, 75440 PARIS CEDEX 09, FRANCE, do hereby declare that I am well acquainted with the French and English languages, and verify that the document attached is a true English language translation of the text of International Patent Application no. PCT/FR00/02105.

Dated this 7 January 2002.

Bertrand LOISEL

METHOD AND DEVICE FOR FORMING TRANSPORT FRAMES FROM CODED-SIGNAL FRAMES AND DEVICE FOR EXTRACTING CODED-SIGNAL FRAMES

The present invention relates to the field of the shaping of digital signals with a view to their transmission, and especially to a method and a device for forming transport frames from coded-signal frames emanating from a source.

The invention applies in particular, but not exclusively, to the transmission on a radio channel of voice signals from a vocoder.

The channel coding procedures used to form transport frames implement error detection and/or correction techniques using redundant codes applied to the coded-signal frames. Often, the bits of the frames produced by the source are cataloged into several classes to which are applied protection measures which are more or less effective against transmission errors, to achieve a compromise between the need to detect or correct any errors as a function of the importance of the information transmitted and the bandwidth required thereby.

In the example of voice communications in the GSM cellular radiocommunication system, the vocoder produces 260 bits per coded-signal frame of 20 ms, of which 50 bits are in class C1a, 132 bits are in class C1b and 78 bits are in class C2. The mechanism for forming the transport frames from the frames of the vocoder is a synchronized mechanism, one transport frame being produced every 20 ms for each voice frame. The bits of classes C1a and C1b are protected by a convolutional code of rate 1/2 allowing the receiver to

correct transmission errors. Before this coding, 3 parity bits are appended to the 50 bits of class C1a to allow the detection of residual errors among these bits, which are the most sensitive. The transport frame formed by the 378 bits produced by the convolutional coder and by the 78 bits of class C2 is transmitted on the radio channel with temporal interleaving with other transport frames. Interleaving is envisaged to best utilize the correction capabilities of the convolutional code given the type of propagation channel of the GSM system.

In the GSM system, it is also envisaged that the physical channel on which the transport frames are transmitted in respect of a given communication can be shared with a fast signaling logical channel associated with this communication. This signaling channel, called the FACCH ("Fast Associated Control Channel"), is formed by a frame stealing mechanism: it gives rise to the loss of a transport frame corresponding to an output frame from the vocoder. This results in a loss of quality at the receiver level, which is only permissible because the stolen frames are in principle rare.

The frame stealing mechanism is not suitable when, on the same physical channel, a non-negligible bandwidth relative to that of the voice communication is needed. This occurs for example when signaling information representing a significant bit rate is multiplexed on the same physical channel as the speech signal. Another case is that of a frequency division multiple access (FDMA) cellular mobile radio-communication station which, when it is communicating with a base station on a traffic channel, has time

intervals for regularly monitoring beacon channels formed by neighboring base stations so as, as the case may be, to allow the communication to be handed over to the base station affording the best radio propagation conditions (see for example French Patent Application No. 99 06345).

Typically, for this kind of application, it is desirable to deploy a channel coding scheme making it possible to transmit the N coded-signal frames emanating from a vocoder for a duration T in M transport frames available for this duration T, to free part of the transmission resource for this duration T to make it possible to multiplex other logical channels or to reserve windows for other functions, e.g. monitoring.

An object of the present invention is to propose such a scheme.

According to the invention, there is proposed a method for forming transport frames, to be transmitted on a communication channel, from coded-signal frames, wherein each coded-signal frame comprises at least one set of bits to be protected against transmission errors, including at least one subset of bits for which a respective error detection code is calculated. Each of said subsets of bits is placed in a transport frame with its respective error detection code, and some at least of the transport frames contain several subsets of bits, emanating from different coded-signal frames and accompanied by their respective error detection codes.

A mixing of the coded-signal frames in the successive transport frames is thus achieved, making it

possible to adjust the flows between the source and the logical communication channel. It is especially advantageous that the method retains the assigning to the coded-signal frames of the protection information as represented by the error detection codes. The decoder can therefore accurately identify the subsets of bits containing errors. It thus avoids the spreading of an error arising in a pointwise localized manner in a transport frame over the various coded-signal frames which supplied subsets of bits to this transport frame.

Said set of bits to be protected corresponds to a protection class. The method is applicable when there is a single protection class in the coded-signal frames, and for which class error detection codes are employed. When there are several protection classes, it is also applicable to each class for which error detection codes are employed. Some at least of these classes may further form the subject of an error correcting coding within each transport frame.

The number of bits of said subsets can vary from one coded-signal frame to another. It is then advantageous to make provision for the number of bits of the error detection code calculated for a subset of bits to be an increasing function of the number of bits of said subset, to obtain uniform protection in the particular class considered.

In each transport frame, the total number of bits originating from said sets of bits to be protected is preferably constant, as is the total number of bits of said error detection codes. One and the same error correcting coding can then be applied to the blocks formed in the transport frames by the subsets of bits

originating from said sets of bits to be protected and by their respective error detection codes.

Another aspect of the invention concerns a device for forming transport frames, to be transmitted on a communication channel, from coded-signal frames, wherein each coded-signal frame comprises at least one set of bits to be protected against transmission errors, including at least one subset of bits. The device comprises means for calculating a respective error detection code for each of said subsets of bits, and multiplexing means for placing each of said subsets of bits in a transport frame with its respective error detection code. The multiplexing means are arranged to place several subsets of bits, emanating from different coded-signal frames and accompanied by their respective error detection codes, in some at least of the transport frames.

A third aspect of the invention concerns a device for extracting coded-signal frames from transport frames received on a communication channel, wherein each coded-signal frame comprises at least one set of bits protected against transmission errors, including at least one subset of bits, the device comprising demultiplexing means for extracting from each transport frame at least one of said subsets of bits, accompanied by a respective error detection code, characterized in that the demultiplexing means are arranged to extract several subsets of bits from some at least of the transport frames, and to distribute these subsets of bits, associated with their respective error detection codes, in different coded-signal frames.

Other features and advantages of the present invention will become apparent in the description below of nonlimiting exemplary embodiments, with reference to the appended drawings, in which:

- figures 1 and 2 are respective schematic diagrams of a transmitter and a receiver implementing the present invention; and
- figures 3 and 4 are schematic diagrams of modules for distributing and extracting bits respectively forming part of the transmitter and of the receiver according to figures 1 and 2.

The invention is described below in its particular application to the transmission of voice signals on a radio channel.

Figures 1 and 2 show the vocoders 1, 11 of the transmitter and of the receiver. The vocoder 1 of the transmitter delivers coded speech-signal frames each comprising n_v bits, which will be processed by the vocoder 11 of the receiver to retrieve the speech signal. The clock of the speech frames is given by a periodic signal CK_v, the period d of the frames being for example 20 ms.

Figures 1 and 2 also show the modulator 2 and the demodulator 12 of the transmitter and of the receiver. The modulator 2 of the transmitter processes transport frames of n_r bits, constructed from the frames produced by the vocoder 1. It forms the radio signal transmitted on an air interface. The radio signal received by the demodulator 12 is processed to retrieve corresponding transport frames, from which the receiver constructs the speech frames supplied to the

vocoder 11.

The tempo of the transport frames is given by a clock signal CK_r. At the receiver level, this clock CK_r is recovered, in a manner known per se, by a synchronization module (not represented). In the example considered here, the structure of the clock CK_r is such that there are M transport frames over a duration T corresponding to N frame periods of the vocoder ($T = N.d$). The transport frames and the speech frames have for example the same duration d, in which case we have $M < N$. The radio channel used for the transmission of the transport frames is thus rendered available for a fraction $(N-M)/N$ of the time. This fraction makes it possible to reserve time windows on the radio channel, to multiplex other logical channels or to accomplish other functions.

In the example illustrated by figures 1 and 2, there are provided a number K of protection classes for the bits emanating from the vocoder 1 ($K \geq 1$). Class 1 corresponds for example to the bits which are perceptually most sensitive to transmission errors, and class K to the least sensitive bits.

A demultiplexer 3 receives the digital output stream from the vocoder 1, separates the bits of the various classes in each frame and supplies them to respective modules 4 whose role is to distribute these bits in the transport frames (it will be noted that the demultiplexer 3 can be implicitly integrated into the vocoder 1). Each distribution module 4 receives the clocks CK_v and CK_r, as well as a frame index i ranging from 0 to M-1, delivered by a counter modulo M 5 regulated by the clock CK_r.

The distribution modules 4 deliver the bits to be inserted into each transport frame i over a span of duration T, which are assembled by a multiplexer 6 to form these transport frames supplied to the modulator 2 at the tempo CK_r.

Symmetrically, transport frames delivered by the demodulator 12 of the receiver are addressed to a demultiplexer 16 which separates the bits pertaining to the various protection classes, and supplies them to respective modules 14. These modules 14 perform the channel decoding operations and extract the bits of the various classes belonging to the successive speech frames. To do this, each module 14 receives the clocks CK_r and CK_v as well as the index i of the transport frames, which is supplied by a counter modulo M 15 regulated by the clock CK_r. For each speech frame, the extraction modules 14 supply the bits of the various classes, which are assembled by a multiplexer 13 (optional) to form the coded-speech frames addressed to the vocoder 11.

Figure 3 illustrates a possible organization of the distribution module 4 for a protection class k ($1 \leq k \leq K$), for which use is made on the one hand of an error detection code, or CRC ("Cyclic Redundancy Checksum"), and on the other hand of an error correcting coding, based on a convolutional code in the example represented.

Each coded-speech frame is regarded as comprising a set of p_k bits for class k (with $\sum_{k=1}^{K} p_k = n_v$). These p_k bits are written to a memory 20 of first in - first out (FIFO) type receiving a

corresponding write command from a unit 21 controlled by the clock CK_v.

Each set of p_k bits is subdivided into one or more subsets of $q_{i,j,k}$ bits read successively from the FIFO memory 20 under the control of a unit 22. The index i is that delivered by the counter 5 and makes reference to the transport frames, while the index j makes reference to the successive coded-signal frames from which bits pertaining to class k and inserted into transport frame i emanate. If $r_{i,k}$ designates the number of bits of class k which are placed in transport frame i, without counting the redundancy bits (i.e. $r_{i,k} = p_k.N/M$ when p_k is divisible by M), then the index j varies from 0 to $J_{i,k}$, the integer numbers $J_{i,k}$ being such that $\sum_{i'=0}^{i} J_{i',k}$ is the integer immediately less than $(i+1).r_{i,k}/p_k$, and $\sum_{j=0}^{J_{i,k}} q_{i,j,k} = r_{i,k}$.

Each subset of $q_{i,j,k}$ bits forms the subject of a CRC calculation by a unit 23 supplying an error detection code of $L_{i,j,k}$ bits. The unit 23 can conventionally consist of a shift register sequentially receiving the bits read from the memory 20, which register is associated with operators devised in accordance with the generating polynomial of the code employed to deliver the bits of the CRC sequentially after having received the subset of $q_{i,j,k}$ bits. When the number $L_{i,j,k}$ of bits of the CRC is variable (as a function of the indices i and j), the calculation unit 23 further comprises switches controlled by a signal indicating the number $L_{i,j,k}$ of bits of the code and making it possible to select the active operators.

The $q_{i,j,k}$ bits read from the FIFO memory 20, followed by the $L_{i,j,k}$ bits of the CRC which are calculated by the unit 23, are written to another memory 24 of FIFO type receiving a corresponding write command from a unit 25. The reading to the FIFO memory 24 is controlled by a unit 26 at the tempo of the clock CK_r. The block of $s_{i,k} = r_{i,k} + \sum_{j=0}^{J_{i,k}} L_{i,j,k}$ bits which is extracted from the FIFO memory 24 at each read corresponds to the $J_{i,k}$ subsets of bits and to the CRCs respectively associated with them. This block is addressed to the coding circuit 27 of the distribution module 4.

The circuit 27 has a conventional structure (shift register and associated operators). The rate ρ of the convolutional coding is chosen as a function of the number $s_{i,k}$ of bits of the block and of the number of bits available for class k in the i-th radio frame of n_r bits. To alter this rate, the circuit 27 can use a conventional procedure for puncturing convolutional codes, while possibly taking account of a known short sequence of bits which is appended to the block of $s_{i,k}$ bits to be coded and serves to initialize the trellis employed by the decoder. At each cycle of the clock CK_r, the bits of the transport frames pertaining to class k are addressed to the multiplexer 6 by the circuit 27.

In the embodiment represented in figure 3, the index j is supplied by a counter 28 reset to 0 at the start of each cycle of the clock CK_r and incremented by a signal delivered by the unit 25 when the writing of a subset of $q_{i,j,k}$ bits and of the corresponding $L_{i,j,k}$ CRC

bits has been performed in the FIFO memory 24. The indices i, j delivered by the counters 5, 28 serve for the addressing in a table 29 stored in the distribution module 4. This table 29 contains the predefined integer numbers $q_{i,j,k}$ and $L_{i,j,k}$, supplied to the units 22, 23, 25 so as to adjust the transfers between the FIFO memories 20, 24 and the CRC calculations. It also contains the integer numbers $s_{i,k}$ supplied to the unit 26 so as to adjust transfers from the FIFO memory 24 to the coder 27.

Figure 4 illustrates a possible organization of an extraction module 14 corresponding to the distribution module 4 of figure 3.

The bits pertaining to class k are received from the demultiplexer 16 by the decoder 37, which utilizes the redundancy introduced into each transport frame by the coder 27 so as to correct any transmission errors. The decoder 37 has a conventional structure, and operates for example according to the Viterbi algorithm. For each transport frame, it delivers a block of $s_{i,k}$ decoded bits written to a memory 34 of FIFO type under the control of a unit 36 regulated by the clock CK_r. A unit 35 successively commands the readings of groups of $q_{i,j,k} + L_{i,j,k}$ bits in the FIFO memory 34. The $q_{i,j,k}$ bits of the "subset" are transferred to another FIFO memory 30, and moreover addressed to a CRC calculation unit 33 operating in the same way as the unit 23 of figure 3.

The unit 33 recalculates the CRC of $L_{i,j,k}$ bits which is associated with the $q_{i,j,k}$ bits of the subset. A comparator 40 receives this recalculated code as well as the $L_{i,j,k}$ CRC bits read from the FIFO memory 34 after

the $q_{i,j,k}$ bits of the subset. The comparator 40 delivers a bit at 0 if the two CRCs coincide, and at 1 otherwise. This bit is addressed to an input of an OR gate 41 whose other input receives another error bit emanating from the correcting decoder 37. This error bit is placed at 1 in the course of the cycle of the clock CK_r when the decoder 37 has estimated that the quality of the frame received was too poor for the decoding to be reliable. The OR gate 41 thus delivers a bit BFI indicating for each subset of $q_{i,j,k}$ bits whether a transmission error has or has not been detected. These bits BFI are supplied to the vocoder 11 of the receiver, which can then take appropriate measures to deal with the error detected, for example an interpolation of parameters.

It should be noted that the detection bits BFI are differentiated as a function of the coded speech-signal frames. Bits of another subset of $q_{i,j',k}$ bits which is placed in the same transport frame i but which belongs to another speech frame ($j' \neq j$) are thus not regarded as erroneous on account of a pointwise error arising in a subset of $q_{i,j,k}$ bits and detected by virtue of the CRC.

The writes to the FIFO memory 30 of the extraction module 14 are controlled by a unit 32, by subsets of $q_{i,j,k}$ bits, and the reads are controlled by a unit 31 at the tempo of the clock CK_v, by sets of p_x bits supplied successively to the multiplexer 13.

Like the distribution module 4 described previously, the extraction module 14 comprises a counter 38 reset to zero at the start of each cycle of the clock CK_r and incremented by a signal emanating

from the unit 32 when the writing of a subset $q_{i,j,k}$ bits has been performed in the FIFO memory 30. This counter 38 delivers the index j of the speech frames. The indices i, j produced by the counters 15, 38 serve for the addressing in a table 39 stored in the module 14. As previously, this table 39 contains the integer numbers $q_{i,j,k}$ and $L_{i,j,k}$ supplied to the modules 32, 33, 35 to adjust the transfers between the FIFO memories 34, 30 and the CRC calculations, as well as the integer numbers $s_{i,k}$ supplied to the unit 36 to adjust the transfers between the decoder 37 and the FIFO memory 34.

If a class k does not form the subject of any error correcting coding, the modules 4 and 14 may have the same structure as in Figures 3 and 4 without the circuits 27 and 37, the blocks of $s_{i,k}$ bits being addressed directly from the memory 24 to the multiplexer 6 and from the demultiplexer 16 to the memory 34.

If a class k does not form the subject of any CRC calculation, it is possible to dispense with the CRC calculation unit, with one of the two FIFO memories and with its units for controlling writing and reading in each of the modules 4, 14. The table 29, 39 can contain just the numbers $s_{i,k}$, the subdivision into subsets of $q_{i,j,k}$ bits being implicit owing to the successive writes and reads to and from the FIFO memory.

It will be noted that the structures represented in the figures are merely some examples from among others coming within the framework of the invention. Thus, each module 4, 14 could comprise just

a single buffer memory. Moreover, in a given application, the numbers $q_{i,j,k}$, $L_{i,j,k}$ and $s_{i,k}$ are fixed, so that it is generally possible to dispense with the counters 28, 38 and with the tables 29, 39.

By way of example, the method according to the invention can be implemented with the following numerical values, corresponding to the application described in patent application FR-99 06345. The speech frames and transport frames have the same duration d of 20 ms. The speech coded on a span of duration T = 180 ms (N = 9) gives rise to the transmission of M = 8 radio frames of n_r = 140 bits. The coded speech-signal frame is composed of n_v = 80 bits split into K = 2 sensitivity classes. The sets of bits corresponding to each class have the same size, i.e. $p_1 = p_2 = 40$, so that $r_{i,k} = 45$ for all the frames and all the classes. No error detection or correction mechanism is applied to the less sensitive class 2 ($s_{i,2} = r_{i,2} = 45$). For the other class, we have chosen $s_{i,1} = 51$. The numbers of bits of the subsets and of the CRCs are indicated in Table I. The rate ρ of the convolutional code, applied by the circuit 27 in the distribution module 4 relating to class 1, is such that $s_{i,1}/\rho + s_{i,2} \leq n_r$, i.e. $51/\rho + 45 \leq 140$. In this application, the rate ρ is therefore of the order of 0.54, this being achievable by puncturing a convolutional code of rate 1/2.

i	$J_{i,1}=J_{i,2}$	$q_{i,0,1}=q_{i,0,2}$	$q_{i,1,1}=q_{i,1,2}$	$L_{i,0,1}$	$L_{i,1,1}$	$L_{i,0,2}=L_{i,1,2}$
0	1	40	5	4	2	0
1	1	35	10	4	2	0
2	1	30	15	4	2	0
3	1	25	20	3	3	0
4	1	20	25	3	3	0
5	1	15	30	2	4	0
6	1	10	35	2	4	0
7	1	5	40	2	4	0

TABLE I

CLAIMS

1. Method for forming transport frames, to be transmitted on a communication channel, from coded-signal frames, wherein each coded-signal frame comprises at least one set of bits to be protected against transmission errors, including at least one subset of bits for which a respective error detection code is calculated, and wherein each of said subsets of bits is placed in a transport frame with its respective error detection code, characterized in that some at least of the transport frames contain several subsets of bits, emanating from different coded-signal frames and accompanied by their respective error detection codes.

2. The method as claimed in claim 1, wherein the number ($q_{i,j,k}$) of bits of said subsets varies from one coded-signal frame to another, and the number ($L_{i,j,k}$) of bits of the error detection code calculated for a subset of bits is an increasing function of the number of bits of said subset.

3. The method as claimed in claim 1 or 2, wherein, in each transport frame, the total number of bits from said sets of bits to be protected is constant, as well as the total number of bits of said error detection codes.

4. Device for forming transport frames, to be transmitted on a communication channel, from coded-signal frames, wherein each coded-signal frame comprises at least one set of bits to be protected against transmission errors, including at least one subset of bits, the device comprising means (23) for calculating a respective error detection code for each

of said subsets of bits, and multiplexing means (6, 20-22, 24-26) for placing each of said subsets of bits in a transport frame with its respective error detection code, characterized in that the multiplexing means are arranged to place several subsets of bits, emanating from different coded-signal frames and accompanied by their respective error detection codes, in some at least of the transport frames.

5. The device as claimed in claim 4, wherein the number ($q_{i,j,k}$) of bits of said subsets varies from one coded-signal frame to another, and the number ($L_{i,j,k}$) of bits of the error detection code calculated for a subset of bits is an increasing function of the number of bits of said subset.

6. The device as claimed in claim 4 or 5, wherein, in each transport frame, the total number of bits originating from said sets of bits to be protected is constant, as well as the total number of bits of said error detection codes.

7. The device as claimed in claim 6, further comprising coding means (27) for applying, in each transport frame, an error correcting code to a block formed by the subsets of bits originating from said sets of bits to be protected and by their respective error detection codes.

8. The device as claimed in any one of claims 4 to 7, wherein the transport frames and the coded-signal frames are of the same duration, and the content of N consecutive coded-signal frames is inserted into M consecutive transport frames, N and M being numbers such that N > M.

9. A device for extracting coded-signal frames from transport frames received on a communication channel, wherein each coded-signal frame comprises at least one set of bits protected against transmission errors, including at least one subset of bits, the device comprising demultiplexing means (16, 30-32, 34-36) for extracting from each transport frame at least one of said subsets of bits, along with a respective error detection code, characterized in that the demultiplexing means are arranged to extract several subsets of bits from some at least of the transport frames, and to distribute these subsets of bits, associated with their respective error detection codes, in different coded-signal frames.

10. The device as claimed in claim 9, wherein the number ($q_{i,j,k}$) of bits of said subsets varies from one coded-signal frame to another, and the number ($L_{i,j,k}$) of bits of the error detection code calculated for a subset of bits is an increasing function of the number of bits of said subset.

11. The device as claimed in claim 9 or 10, wherein, in each transport frame, the total number of bits originating from said sets of bits to be protected is constant, as well as the total number of bits of said error detection codes.

12. The device as claimed in claim 11, further comprising decoding means (37) for correcting any transmission errors in a block formed, in each transport frame, by the bits pertaining to said sets of protected bits and by said error detection codes.

13. The device as claimed in any one of claims 9 to 12, wherein the transport frames and the coded-signal

frames are of the same duration, and the content of N consecutive coded-signal frames is extracted from M consecutive transport frames, N and M being numbers such that N > M.

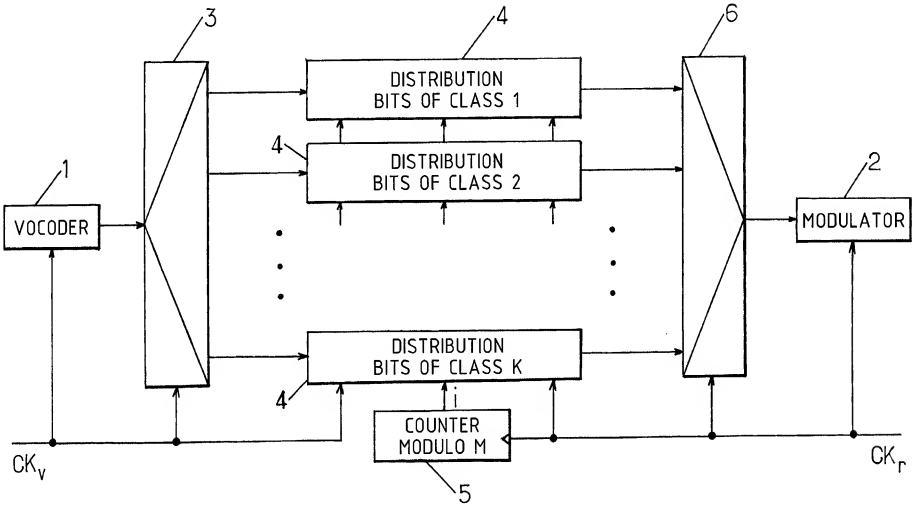

FIG.1

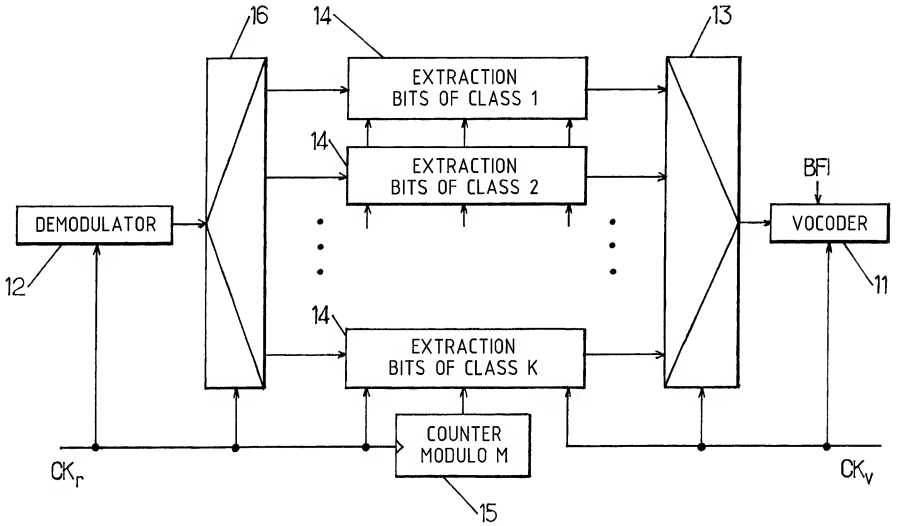

FIG. 2

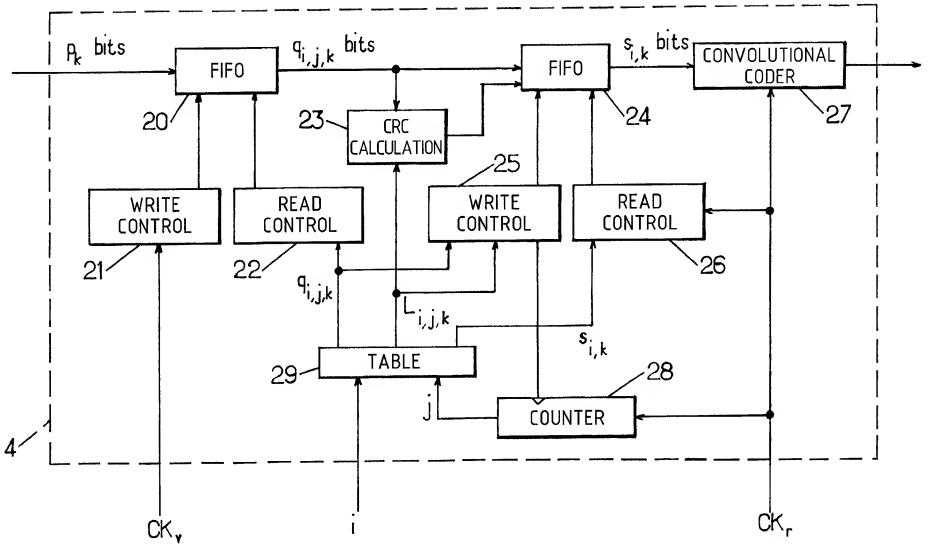
P_k bits
FIFO
$q_{i,j,k}$ bits
FIFO
$s_{i,k}$ bits
CONVOLUTIONAL CODER
20
23
CRC CALCULATION
24
27
25
WRITE CONTROL
READ CONTROL
WRITE CONTROL
READ CONTROL
21
22
26
$q_{i,j,k}$
$L_{i,j,k}$
$s_{i,k}$
29
TABLE
28
j
COUNTER
4
CK_v
i
CK_r

FIG.3

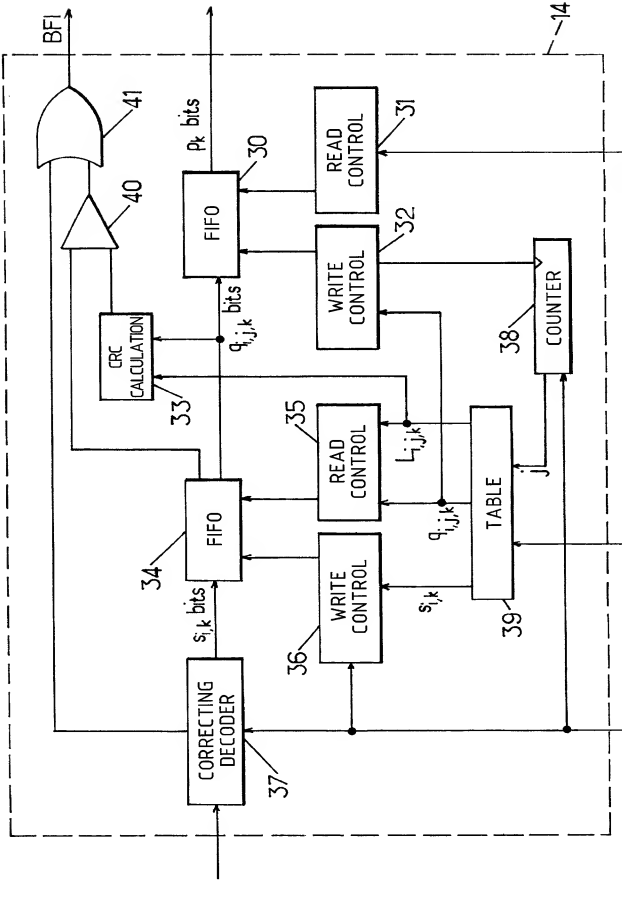

FIG.4

Attorney's Docket No.: US PATENT

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD AND DEVICE FOR FORMING TRANSPORT FRAMES FROM CODED-SIGNAL FRAMES AND DEVICE FOR EXTRACTING CODED-SIGNAL FRAMES

the specification of which

- [X] is attached hereto.
- [ ] was filed on 21 July 2000 as
  - [ ] United States Application Number _____
  - [ ] Or PCT International Application Number PCT/FR00/02105
  - [ ] And was amended on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate Issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s):			Priority Claimed	
99 09679	FR	26/07/1999	x	
Number	(Country)	(Day/Month/Year Filed)	Yes	No
Number	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under title 35, United States Code, Section 119(e) of the United States provisional application(s) listed below:

(Application Number) (Filing Date)

(Application Number) (Filing Date)

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

PCT/FR00/02105	21/07/2000	
(Application Number)	Filing Date	(Status-patented, pending, abandoned)

I hereby appoint Timothy N. Trop, Reg. No. 28,994; Fred G. Pruner, Jr., Reg. No. 40,779, Dan C. Hu, Reg. No. 40,025 and Ruben S. Bains, Reg. No. 46,532, my patent attorneys, of TROP, PRUNER & HU, P.C., with offices located at 8554 Katy Freeway, Ste. 100, Houston, TX 77024, telephone (713) 468-8880, my patent attorneys; with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send correspondence to Dan C. Hu, TROP, PRUNER & HU, P.C., 8554 Katy Freeway, Ste. 100, Houston, TX 77024 and direct telephone calls to Dan C. Hu, (713) 468-8880.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Post Office Address: THE SAME AS ABOVE	